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<h1 style="margin: 0;">FEE TRANSMITTAL</h1> <p style="font-size: small; margin: 5px 0;">Patent fees are subject to annual revision.</p>		Complete If Known	
		Application Number	10/766,564
		Filing Date	29 January 2004
		First Named Inventor	TAE-SUNG KIM
		Examiner Name	ERDEM, FAZLI
Group/Art Unit		2826	
TOTAL AMOUNT OF PAYMENT	(\$) 180.00	Attorney Docket No.	P57001

METHOD OF PAYMENT (check one)	FEE CALCULATION																																																																																																																																																																								
<p>1. Payment Enclosed: (CHECK #50537)</p> <p><input checked="" type="checkbox"/> Check <input type="checkbox"/> Credit Card <input type="checkbox"/> Money Order <input type="checkbox"/> Other</p> <p><input type="checkbox"/> Charge Any Additional Fee Required Under 37 C.F.R. §1.16 and 1.17.</p> <p><input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27</p> <p>2. The Commissioner is hereby authorized to charge any deficiency and credit any over payments to:</p> <p>Deposit Account Number: <u>02-4943</u></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Fee Code</th> <th style="width: 10%;">Fee (\$)</th> <th style="width: 10%;">Fee Code</th> <th style="width: 10%;">Fee (\$)</th> <th style="width: 50%;">Fee Description</th> <th style="width: 10%;">Fee Paid</th> </tr> </thead> <tbody> <tr> <td colspan="6" style="text-align: center;">MISCELLANEOUS</td> </tr> <tr> <td>1801</td> <td>\$790</td> <td>2801</td> <td>\$395</td> <td>Request for continued examination (RCE)</td> <td>\$</td> </tr> <tr> <td>1806</td> <td>\$180</td> <td></td> <td></td> <td>Submission of an IDS</td> <td>\$180.00</td> </tr> <tr> <td>1814</td> <td>\$130</td> <td>2814</td> <td>\$65</td> <td>Statutory disclaimer</td> <td>\$</td> </tr> <tr> <td>8021</td> <td>\$40</td> <td></td> <td></td> <td>Recordation of assignment per property</td> <td>\$</td> </tr> <tr> <td colspan="6" style="text-align: center;">TRADEMARK</td> </tr> <tr> <td>6001/7001</td> <td></td> <td></td> <td>\$335</td> <td>Application for registration, per class</td> <td>\$</td> </tr> <tr> <td>6002/7002</td> <td></td> <td></td> <td>\$100</td> <td>Amendment to Allege Use, per class</td> <td>\$</td> </tr> <tr> <td>6003/7003</td> <td></td> <td></td> <td>\$100</td> <td>Statement of Use, per class</td> <td>\$</td> </tr> <tr> <td>6004/7004</td> <td></td> <td></td> <td>\$150</td> <td>Request for six-month extension of time, per class</td> <td>\$</td> </tr> <tr> <td>6205/7205</td> <td></td> <td></td> <td>\$100</td> <td>\$8 affidavit, per class</td> <td>\$</td> </tr> <tr> <td>6208/7208</td> <td></td> <td></td> <td>\$200</td> <td>\$15 affidavit, per class</td> <td>\$</td> </tr> <tr> <td>6201/7201</td> <td></td> <td></td> <td>\$400</td> <td>Application for renewal, per class</td> <td>\$</td> </tr> <tr> <td>6403/7403</td> <td></td> <td></td> <td>\$100</td> <td>Ex parte appeal, per class</td> <td>\$</td> </tr> <tr> <td colspan="6" style="text-align: center;">PETITION</td> </tr> <tr> <td>1462</td> <td></td> <td></td> <td>\$400</td> <td>Petitions to Director (Group I)</td> <td>\$</td> </tr> <tr> <td>1463</td> <td></td> <td></td> <td>\$200</td> <td>Petitions to Director (Group I)</td> <td>\$</td> </tr> <tr> <td>1464</td> <td></td> <td></td> <td>\$130</td> <td>Petitions to Director (Group II)</td> <td>\$</td> </tr> <tr> <td>1452</td> <td>\$500</td> <td>2452</td> <td>\$250</td> <td>Petitions to revive unavoidably abandoned application</td> <td>\$</td> </tr> <tr> <td>1453</td> <td>\$1500</td> <td>2453</td> <td>\$750</td> <td>Petitions to revive unintentionally abandoned application</td> <td>\$</td> </tr> <tr> <td colspan="6" style="text-align: center;">PATENT MAINTENANCE</td> </tr> <tr> <td>1551</td> <td>\$900</td> <td>2551</td> <td>\$450</td> <td>Due at 3.5 years</td> <td>\$</td> </tr> <tr> <td>1552</td> <td>\$2300</td> <td>2552</td> <td>\$1150</td> <td>Due at 7.5 years</td> <td>\$</td> </tr> <tr> <td>1553</td> <td>\$3800</td> <td>2553</td> <td>\$1900</td> <td>Due at 11.5 years</td> <td>\$</td> </tr> <tr> <td colspan="6">Other Fee (specify) _____ \$</td> </tr> <tr> <td colspan="6">Other Fee (specify) _____ \$</td> </tr> <tr> <td colspan="6">Other Fee (specify) _____ \$</td> </tr> </tbody> </table>	Fee Code	Fee (\$)	Fee Code	Fee (\$)	Fee Description	Fee Paid	MISCELLANEOUS						1801	\$790	2801	\$395	Request for continued examination (RCE)	\$	1806	\$180			Submission of an IDS	\$180.00	1814	\$130	2814	\$65	Statutory disclaimer	\$	8021	\$40			Recordation of assignment per property	\$	TRADEMARK						6001/7001			\$335	Application for registration, per class	\$	6002/7002			\$100	Amendment to Allege Use, per class	\$	6003/7003			\$100	Statement of Use, per class	\$	6004/7004			\$150	Request for six-month extension of time, per class	\$	6205/7205			\$100	\$8 affidavit, per class	\$	6208/7208			\$200	\$15 affidavit, per class	\$	6201/7201			\$400	Application for renewal, per class	\$	6403/7403			\$100	Ex parte appeal, per class	\$	PETITION						1462			\$400	Petitions to Director (Group I)	\$	1463			\$200	Petitions to Director (Group I)	\$	1464			\$130	Petitions to Director (Group II)	\$	1452	\$500	2452	\$250	Petitions to revive unavoidably abandoned application	\$	1453	\$1500	2453	\$750	Petitions to revive unintentionally abandoned application	\$	PATENT MAINTENANCE						1551	\$900	2551	\$450	Due at 3.5 years	\$	1552	\$2300	2552	\$1150	Due at 7.5 years	\$	1553	\$3800	2553	\$1900	Due at 11.5 years	\$	Other Fee (specify) _____ \$						Other Fee (specify) _____ \$						Other Fee (specify) _____ \$					
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SUBMITTED BY		Complete (if applicable)	
Typed or Printed Name	Robert E. Bushnell, Esq.	Reg. Number	27,774
Signature		Date	10 March 2006
		Deposit Account User ID	

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PATENT
P57001

THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

TAE-SUNG KIM

Serial No.: 10/766,564

Examiner: ERDEM, FAZLI

Filed: 29 January 2004

Art Unit: 2826

For: NOVEL CONDUCTIVE ELEMENTS FOR THIN FILM TRANSISTORS USED IN
A FLAT PANEL DISPLAY

INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O.Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with 37 C.F.R. §1.56, and §§1.97 and 1.98 as amended, Applicant cites, describes, and provides copies of the following art references. Under 37 C.F.R. §1.98(a)(2) however, copies of U.S. patent reference(s) are not provided.

US PATENT REFERENCE:

- United States Patent No. 6,414,738 to Fujikawa, entitled *DISPLAY*, issued on 2 July 2002.
- United States Patent No. 5,747,879 to Rastogi, *et al.*, entitled *INTERFACE BETWEEN TITANIUM AND ALUMINUM-ALLOY IN METAL STACK FOR INTEGRATED CIRCUIT*, issued on 5 May 1998.
- United States Patent No. 6,255,706 to Watanabe, *et al.*, entitled *THIN FILM TRANSISTOR AND METHOD OF MANUFACTURING SAME*, issued on 3 July 2001.
- United States Patent Application No. 2001/0043175 to Yasukawa, entitled *LIQUID*

CRYSTAL PANEL SUBSTRATE, LIQUID CRYSTAL PANEL, AND ELECTRONIC EQUIPMENT AND PROJECTION TYPE DISPLAY DEVICE BOTH USING THE SAME, issued on 22 November 2001.

- United States Patent Application No. 2002/0076574 to Cabral, Jr., *et al.*, entitled *INTERCONNECTS WITH TI-CONTAINING LINERS*, issued on 20 January 2002.
- United States Patent Application No. 2002/0085157 to Tanaka, *et al.*, entitled *ACTIVE MATRIX ADDRESSING LIQUID-CRYSTAL DISPLAY DEVICE*, issued on 4 July 2002.

FOREIGN PATENT REFERENCE:

- European Patent Publication No. 1001463 to Cichy, *et al.*, entitled *ALUMINUM INTERCONNECTS FOR INTEGRATED CIRCUITS COMPRISING TITANIUM UNDER AND OVERLAYERS*, published on 17 May 2000 (with English abstract).

OTHER DOCUMENTS:

- European Office action for European Patent Application No. 04250453.0, issued on 30 January 2006.
- An article "Relationship between copper concentration and stress during electromigration in an Al(0.25 at. % Cu) conductor line" written by Kao, *et al.* published in Journal of Applied Physics, Vol. 93, no. 5, pp 2516-2527, on 1 March 2003 (with English abstract).
- An article "The microstructure of submicrometer wide planar-reactive ion etched versus trench-damascene AlCu lines: written by Rodbell, *et al.*, published in Journal of Applied Physics, Vol. 88, no. 9, pp 5093-5099, on 1 November 2000 (with English abstract).
- An article "Stress Induced Metallurgical Effects in Ti/TiN/AlCu/TiN Metal Stacks" written by Koller, *et al.*, published in Stress Induced Phenomena in Metallization,

Vol. 612, pp 235-246, on April 2002 (with English abstract).

DISCUSSION

Fujikawa US'738, according to the European Office action in applicant's European patent application Serial No. 04250453.0, discloses that in a display device such as a liquid crystal display device, in order to connect electrodes and wiring with a low resistance, the first titanium nitride film having a hexagonal crystal structure for preventing silicon diffusion is intervened between the drain region composed of a polycrystalline silicon film and the drain electrode composed of an aluminum film. the second titanium nitride film having a hexagonal crystal structure which can be deposited by sputtering with the same target as that for the titanium film and the first titanium film is intervened between the transparent display electrode composed of an ITO film and the drain electrode composed of an aluminum film in order to bring them into ohmic contact. Since the second titanium nitride film is resistant to an etchant for the silicon oxide film and to an etchant for the ITO film, the drain electrode is protected when etching is performed.

Rastogi US'879, discloses that an improvement in a metal stack used for interconnecting structures in an integrated circuit. The improvement comprises the entrapping in a titanium layer of nitrogen at the interface where the titanium layer contacts a bulk conductor layer such as an aluminum-copper alloy layer. The entrapped nitrogen prevents the formation of any substantial amount of titanium aluminide thereby reducing current densities and also improving the electromigration properties of the stack. As currently preferred, the nitrogen is entrapped in approximately the first 30Å of the titanium layer.

Watanabe US'706, discloses that a thin film transistor wherein at least one of a gate electrode and/or a scanning line therefor and source/drain electrode and/or signal lines therefor comprises a laminated wiring structure in which a main wiring layer formed of a metal selected from

Al and Cu or an alloy based on the metal is sandwiched between an underlying wiring layer and an overlayer, the underlying and overlaying wiring layers being formed of a material based on a metal or alloy of metals and containing nitrogen, the metal being selected from Ti, Mo, W, Cr, Al and Cu, and the materials used in the underlying and overlaying wiring layers being different from each other. Alternatively, the underlying and overlaying wiring layers are formed of a material based on the same metal or alloy of metals and containing nitrogen, the metal being selected from Ti, Mo, W, Cr, Al and Cu, and contents of nitrogen in the underlying and overlaying wiring layers being different from each other. A method of manufacturing such a thin film transistor is also disclosed.

Yasukawa US'175, discloses that the present invention is a liquid crystal panel substrate that comprises; pixel units each having a pixel electrode, to be used as a reflective electrode and arranged in a matrix pattern on a substrate, and a switching element controlling a voltage applied to the pixel electrode; wherein between the pixel electrode and a conductive layer forming a terminal electrode of the switching element, a contact hole is provided for connecting the pixel electrode and the terminal electrode. A light-shielding layer, having an opening surrounding the portion in which the contact hole is formed, and having no opening in regions between a plurality of adjacent pixel electrodes, is formed between the pixel electrode and the conductive layer. Harmful effects due to light leaking through a space between the pixel electrodes can thereby be prevented.

Cabral US'574, discloses that an electrical conductor for use in an electronic structure is disclosed which includes a conductor body that is formed of an alloy including between about 0.001 atomic % and about 2 atomic % of an element selected from the group consisting of Ti, Zr, In, Sn and Hf; and a liner abutting the conductor body which is formed of an alloy that includes Ta, W, Ti, Nb and V. The invention further discloses a liner for use in a semiconductor interconnect that is formed of a material selected from the group consisting of Ti, Hf, In, Sn, Zr and alloys thereof, $TiCu_3$, $Ta_{1-x}Ti_x$, $Ta_{1-x}Hf_x$, $Ta_{1-x}In_x$, $Ta_{1-x}Sn_x$, $Ta_{1-x}Zr_x$.

Tanaka US'157, discloses that an active matrix addressing LDC device having an active matrix substrate on which conductive lines are formed is provided, which suppress the Al hillock without complicating the structure of the lines and which decreases the electrical connection resistance increase at the terminals of the lines, thereby improving the connection reliability. The device comprises an active matrix substrate having a transparent, dielectric plate, thin-film transistors (TFTs) arranged on the plate, and pixel electrodes arranged on the plate. Gate electrodes of the TFTs and scan lines have a first multilevel conductive structure. Common electrodes and common lines may have the first multilevel conductive structure. Source and drain electrodes of the TFTs and signal lines may have a second multilevel conductive structure. Each of the first and second multilevel conductive structures includes a three-level TiN/Ti/Al or TiN/Al/Ti structure or a four-level TiN/Ti/Al/Ti structure. Each of the TiN film of the first and second structures has a nitrogen concentration of 25 atomic % or higher. The Al film may be replaced with an Al alloy.

Cichy EP'463, discloses that an interconnect for an integrated circuit includes an underlayer comprising titanium having reduced contamination for improved electromigration and for supporting another layer. An intermediate layer comprising aluminum is deposited over the underlayer. An overlayer comprising titanium having increased contamination relative to the underlayer to provide a reduced sheet resistance is applied over the intermediate layer. The resulting interconnect has improved reliability and functionality. A method is also provided.

Kao, discloses that synchrotron-based x-ray microbeam fluorescence and diffraction have been used for *in situ* measurements of Cu concentration and biaxial stress in a 200- μm -long, 10- μm -wide Al(0.25 at. % Cu) conductor line with 1.5- μm -thick SiO_2 passivation during electromigration. Measurements over 48 h with $T=300^\circ\text{C}$ and $j=1.5\times 10^5 \text{ A/cm}^2$ show that a stress gradient of 3 MPa/ μm develops over the upstream 130 μm of line length where Cu concentration drops below 0.15 at. %, and a 10- μm -long void develops at the cathode end of the line, but little change in stress occurs over the downstream 70 μm of line length where Cu concentration remains above 0.15 at. %. These experimental results have been reproduced by a finite element model in which the downstream Cu transport is accompanied by a counter flow of Al in the upstream direction, and downstream Al

motion is clocked where the local Cu concentration is above ~0.15 at. %. Defect mediated coupling between Al and Cu diffusive flows, e.g., Cu-vacancy binding, is proposed as the cause for the counterflow of Al when the Cu concentration is above the critical concentration, and as the mechanism by which Cu reduces the rate of electromigration damage in Al(Cu) conductor lines.

Rodbell, discloses that the microstructure was measured for AlCu lines, formed using either a traditional planar metal subtractive etch process or a newly developed hot AlCu-trench-damascene process. It was found that 0.35 μm wide damascene AlCu lines formed a large grained bamboo microstructure with little or no Al (III) texture. The local crystallographic texture was measured in a scanning electron microscope using electron backscatter pattern analysis often referred to as backscatter Kikuchi diffraction. Damascene structures consisted of AlCu films deposited at greater than 400°C onto Ti or Ti/TiN into preformed amorphous SiO₂ trenches, 0.3-5.0 μm wide by 0.4 μm deep, followed by aluminum chemical mechanical polishing to remove the metal overburden. Standard planar metal control samples consisted of blanket Al or AlCu films deposited onto either an amorphous SiO₂ substrate or onto SiO₂/Ti/TiN substrates, followed by subtractive etching to define 0.45-10 μm wide lines as well as large (e.g. 10x10 μm^2) pads. The planar metal samples exhibited either little change or a slight strengthening of their (III) fiber texture with decreasing line width; this was in sharp contrast to the damascene films in which a marked weakening in the (III) fiber texture with decreasing line width was found. In addition a trimodal (III) texture distribution developed in trenches where TiAl₃ intermetallic formed. the role of intermetallic formation (TiAl₃), elevated (>400°C) AlCu deposition temperature, large bamboo grain size, local AlCu crystallographic texture and differences in sidewall coverage between subtractive etched and trench-damascene processed AlCu on film microstructure are examined.

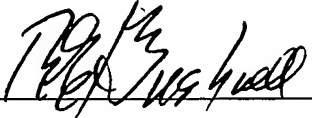
Koller, discloses that integrated circuits with aluminum metallization for products with high current densities need a metal stack with liner and antireflective coating (ARC) which can fulfill several requirements (e.g. low sheet resistance, high reliability, smooth surface, good adhesion, thermal stability, etc.). In this work different multilayer metal stacks are investigated and several phenomena which can be observed after thermal annealing of Ti/TiN/AlCu/TiN stacks are described and discussed. Metallurgical, electrical and mechanical properties of different layer combinations are investigated after thermal annealing and stress tests are done to compare the electromigration and life time behaviour of each metal stack. For all investigated metal stacks it is shown that an interface reaction between Ti and aluminum will form TiAl_3 phase. Even with very thick TiN layers on top of titanium or with only TiN liner the phase formation occurred. Explanations and models for the formation of different phenomena (hillocks, depressions and elevations), are discussed. The origin of each phenomena is stress related and assisted either by the liner material and/or the ARC layer. A qualitative model which explains the different observed layer reactions is discussed.

Pursuant to 37 CFR §1.97(d), the undersigned attorney hereby certifies that each item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign patent application not more than three (3) months prior to the filing of the statement.

The citation of the foregoing references is not intended to constitute an assertion that other or more relevant art does not exist. Accordingly, the Examiner is requested to make a wide-ranging and thorough search of the relevant art.

Pursuant to 37 C.F.R. §1.97(c)(2), the fee set forth under 37 C.F.R. §1.17(p) of \$180.00 accompanies this Information Disclosure Statement. Should the check become lost, be deficient in payment, or should other fees be incurred, the Commissioner is authorized to charge Deposit Account No. 02-4943 of Applicant's undersigned attorney in the amount of such fees.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "R. E. Bushnell", is written over a horizontal line.

Robert E. Bushnell

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INFORMATION DISCLOSURE STATEMENT

SERIAL NUMBER 10/766,564

DOCKET NO. P57001

APPLICANT TAE-SUNG KIM

FILING DATE 29 January 2004

GROUP 2826

10/766,564-1449 (PAGE 1 OF 1)

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U.S. PATENT DOCUMENTS

EXAMINER	DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE
	6,414,738	07/02	Fujikawa			
	5,747,879	05/98	Rastogi, et al.			
	6,255,706	07/01	Watanabe, et al.			
	2001/0043175	11/01	Yasukawa			
	2002/0076574	06/02	Cabral, Jr., et al.			
	2002/0085157	07/02	Tanaka, et al.			

FOREIGN PATENT DOCUMENTS

TRANSLATION

DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	YES	NO
EP 1 011 463	05/00	EUROPE			Abstract	

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, etc.)

	European Office Action of the European Patent Application No. 04250453.0, mailed on 30 January 2006
	An article "Relationship between copper concentration and stress during electromigration in an Al(0.25 at. % Cu) conductor line" written by Kao, et al. published in Journal of Applied Physics, Vol. 93, no. 5, pp 2516-2527, on 1 March 2003.
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EXAMINER:

DATE CONSIDERED:

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP §609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.